

**TRANSLATION AND ADAPTATION OF THE
ADDENBROOKE'S COGNITIVE EXAMINATION-
REVISED (ACE-R)
FOR
THE SLOVAK POPULATION**

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ABSTRACT

The Addenbrooke's Cognitive Examination Revised (ACE-R) is a brief and highly sensitive screening instrument designed to detect a cognitive impairment in people with dementia. Its accuracy and usefulness in the diagnosis is reported by a number of validation studies worldwide. However, the test is not used a lot in the post-communist bloc. Therefore the main aim of the current study was to translate and adapt the ACE-R into Slovak, evaluate its psychometric properties in the elderly population of the country and check its generalizability and cross-cultural adaptability. It was also attempted to compare its usefulness and accuracy with the MMSE and show its advantage over this dementia screening tool widely used in Slovakia.

A patient group, composed of 31 people with dementia, was compared with 52 healthy individuals matched for age, gender and educational level. Standard statistical tests were applied in order to evaluate the psychometric properties of the Slovak ACE-R adaptation. Education and age were shown to have an effect on the test performance. Reliability of the test was excellent (Cronbach's $\alpha = 0.9$), so was the diagnostic accuracy (AUC value of 0.989). The accuracy and partial cut-offs of all subtests were also calculated using the ROC curve with obtaining an excellent or good value of the AUC. Two cut-off scores were defined, 80 for MCI (sensitivity= 90%, specificity= 100%) and 77 for dementia (94%, 90%). Furthermore, the performance of the patient group and also the participants with a borderline score was analysed in detail.

The Slovak ACE-R was proven to be a practical and sensitive screening tool for identification of a cognitive impairment in people with dementia in Slovakia.

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1 INTRODUCTION

1.1. World population aging

The population all over the world has been aging rapidly over the last decades and it is expected that this trend will become even more dramatic in the near future. The proportion of the elderly is, so far, the most marked in the Western countries but the dynamics of aging will soon affect also the countries of Eastern block (Uhlenberg, 2009).

The developed countries such as the United States, Great Britain, Germany or Japan, experiencing a significant rise of people at retirement age, realize that substantial growth of the older population represents a challenge for a modern society on a range of different issues (Uhlenberg, 2009).

“The report 65+ in the United States” published in 2005 provides a description of the American population over 65. It says that in the 20th century the number of people in this group increased from 3.1 million to more than 35 million and its size will probably be double by the year 2030 (Wan et al., 2005).

Great Britain reports that today, for the first time in history of the country, people older than 65 years outnumber people younger than 16 years and by the year of 2025 it is expected that more than a third of population in UK will be older than 55 (Gee et al., 2000).

Similar trend is present in all countries of the European Union (EU) where is expected that people over 65 years will represent about 29.5% of the EU population by the year 2060 what is dramatic in comparison to the current situation (17.4% in 2010) (21st Century Challenges, 2011).

The governments of these countries are aware of the impact which the ageing population will have on public finances and therefore have started taking action, especially in the fields of social and pension systems. It is, however, crucial to also modernise the healthcare services and support the prevention and research of chronic diseases related to older population which probably put the most considerable pressure on public finance (Wan et al., 2005).

1.2.Age-related cognitive disorders

The fact is that the aging of population causes a dramatic increase in age-related cognitive disorders such as dementia which not only negatively affects the health system and economy of the countries but also the quality of life of those affected and their families (Uhlenberg, 2009).

Dementia is an umbrella term for a group of diseases causing a progressive and irreversible cognitive decline in elderly people including *Alzheimer's disease*, *Vascular dementia*, *Dementia with Lewy Bodies*, *Fronto-temporal dementia* and others. The affected person is gradually losing the ability to manage their own life and experiences difficulties in every day activities and personal care. In 2005 the estimation of people having dementia worldwide was 24.3 million and an annual increase of 4.6million new cases was anticipated (Hummelová-Fanfrdlová et al., 2006).

A common term in dementia diagnosis nowadays is also "*Mild Cognitive Impairment*" (*MCI*) which describes people having some degree of cognitive impairment who, however, do not yet meet the criteria for being diagnosed with dementia. A significant number of these individuals develop some type of dementia in following years while some of them stay at the same level of impairment and do not get worse. The heterogeneity and unpredictability of this group are, therefore, the reasons why a regular monitoring and also accurate diagnostic methods are required for these patients (Crawford, 2010).

1.3.Dementia diagnosis and assessment

Diagnosis of dementia and subsequent care has, therefore, become an area of great interest over the last few years. Especially development of early diagnostic methods has been prioritised in the dementia research. The reason is that early and accurate diagnosis has been proven to be crucial in dementia treatment. There is some evidence showing that appropriate intervention following the early detection of dementia can greatly improve the quality of life and prolong the self-sufficiency of those affected. The effective post-diagnosis treatment and support is therefore dependent on accurate assessment which is sensitive even to slight cognitive impairment in the individuals (Mathuranath et al., 2007).

Another important feature of such assessments would be the ability to specify the domain where the impairment is localized and this way help distinguish the dementia subtypes. This information is essential and enables to start appropriate intervention

such as prescription of correct medication, learning compensation strategies, participation on cognitive trainings, etc. (Stokholm et al., 2009).

As already mentioned, there is an increasing number of older patients with suspected dementia. Consequently, there is a high demand for the development of a screening method which would be brief, sensitive to early cognitive deficits and also easy to administer (Konstantinopoulou et al., 2011).

Several assessments trying to meet the mentioned requirements have been developed and widely used in the world over the last years.

The most commonly used screening method for cognitive impairment detection is certainly the Mini Mental State Examination (MMSE). Its great advantage is the brevity, easy administration and wide accessibility for clinicians, GPs or care workers since no special training is required for its use (Raisová et al., 2011).

The MMSE assesses different mental abilities of the individual such as memory, orientation and language. A maximum possible score is 30 points. Score equal or greater than 25 is considered normal, 21-24 is classified as a mild impairment, 20-10 as a moderate one and individuals obtaining score lower than 10 points are considered to be severely cognitively impaired (Newman, 2005).

This screening tool can be used not only for initial cognitive impairment diagnosis but serves also for monitoring the changes in patients who have already been diagnosed with dementia. It gives the indication of how quickly the illness progresses and also how severe the symptoms are. Alzheimer's patients with no treatment might lose from two to four points on the test each year (Pigliatile et al., 2011).

Even if MMSE is used worldwide and accepted as a valid tool for dementia detection, there is still more evidence showing that the test has several limitations and insufficiencies (Hoops et al., 2009).

One of its weaknesses is the proportion of the tasks measuring functioning of various cognitive domains. The problem is, for example, that one third of the test items assesses orientation in time and space while only one task, "repetition of three words", focuses on short-term memory testing. Impairment of short-term memory is, however, rather important symptom in early stage of dementia of various types and therefore should be tested more carefully (Hummelová-Fanfrdlová et al., 2006).

Not only this limitation but also relatively simple tasks assessing individuals' language functions disable the MMSE to be a sensitive tool for detection of early cognitive

impairments. Moreover, the test does not provide a screening of all cognitive domains. It completely lacks the verbal fluency tasks, picture naming tasks and also items assessing the executive functions. These are reasons why the test is not capable of differentiating between different dementia types and is rather limited to provide only a global or overall dementia score (Raisová et al., 2011).

The Montreal Cognitive Assessment (MOCA) is another cognitive screening test which might be used in dementia diagnosis. It is a brief 30-point assessment examining various cognitive abilities. The task assessing the short-term memory contains learning of five words and their delayed recall. Clock drawing task and drawing of 3-dimensional cube are used to examine individual's visuo-spatial abilities. Executive functions are screened using a verbal abstraction task and trail making task. Picture naming task, repetition of sentences and verbal fluency task are used to assess the language abilities of the individual. Several items are assessing also attention, concentration, orientation or working memory (Nasreddine et al., 2005).

There is some evidence that this tool is fairly sensitive for detection of mild cognitive impairment in patients, better predicts the rehabilitation outcome and is also more accurate in longitudinal monitoring of the disease progress than the MMSE. However, it does not provide the screening of functions of different cognitive domains and also its validity has never been thoroughly tested (Hummelová-Fanfrdlová et al., 2006).

The Cambridge Cognitive Examination (CAMCOG) also seems to be a better and more accurate tool for a diagnosis of dementia than the MMSE. It is a brief battery of tests sensitive to early stages of cognitive impairment and assessing a wide range of cognitive domains such as orientation, attention, perception, abstract thinking, memory, language, praxis and calculation. Its administration takes approximately 20 minutes and a total score of 107 points is possible to obtain on 61 tasks which include also all MMSE items (Huppen et al. 1995).

Using the CAMCOG enables the clinicians to detect a qualitative change of a cognitive functioning and also, to some extent, estimate the severity of the deficit in a specific cognitive domain. The breadth and brevity of the CAMCOG makes it an attractive neuropsychological tool for use in clinical practise (De Jager et al., 2003).

Even though these and several other screening tools have been developed over the years and proved to meet better the requirements for modern dementia diagnosis, the MMSE

has still remained the most popular and world-widely used testing method in practise (Bak, 2006).

Hodges and his colleagues from Addenbrooke's Hospital of the University of Cambridge, however, attempted to change this trend by presenting a new test "*Addenbrooke's Cognitive Examination (ACE)*" in 2000 (Bier et al., 2005).

1.4. The Addenbrooke's Cognitive Examination

ACE is a brief bedside neuropsychological screening battery that provides a detection of mild dementia and is also efficient in differential diagnosis since it is able to distinguish between Alzheimer's disease and Fronto-temporal dementia (Larner, 2007). It incorporates all the MMSE which is expanded on the items assessing the cognitive domains such as memory, visuo-spatial abilities or language and also includes the subtest evaluating the verbal fluency (Yoshida et al., 2009).

This dementia screening tool has been adopted in many countries and translated into various languages because its sensitivity, specificity and accuracy for dementia diagnosis have been confirmed by several validation studies (Konstantinopoulou et al., 2011).

Its use in clinical practise, however, revealed some weaknesses of several items which led to their improvement and developing of the *Addenbrooke's Cognitive Examination Revised (ACE-R)* in 2006 by Mioshi (Mioshi et al., 2006).

1.4.1. The Addenbrooke's Cognitive Examination Revised (ACE-R)

In this new version, the content is modified which facilitates its cross-cultural usage and translation into different languages. The ACE-R has in comparison to its original version higher internal consistency, higher sensitivity, better construct validity, decreased ceiling effects and is also easier to administer. The ACE-R shows to detect dementia with high sensitivity and specificity (94% and 89%) when using a cut-off score of 88 out of 100 (Mioshi et al., 2006).

Another advantage of ACE-R over the other screening tools is that it is not expensive, available online, it takes about 15 minutes to administer it and no additional equipment or special training is required for its use in clinical practise.

All explanation and information on how to score the individual tasks can be found in Guide of instructions for ACE-R. This guide is very clear and useful because it presents various examples of acceptable answers as well as models of possible drawings with explanations of how to score them correctly. The practise effect is also minimized in

ACE-R by creating three alternate versions which differ between each other in the stimuli for assessing the anterograde memory (name and address recall) (Carvalho et al., 2010).

ACE-R screens five cognitive domains which are divided into five subtests accordingly adding up to the total score of 100. These are attention and orientation (18 points), memory (26 points), verbal fluency (14 points), language (26 points) and visuo-spatial abilities (16 points). The possibility to evaluate each of these subtests individually allows the practitioners not only to see if there is any general cognitive impairment in patients but also to localize this deficit to a specific cognitive domain what is crucial for differential diagnosis and calculating the VLOM ratio (Bak et al., 2007).

1.4.2 The VLOM ratio

The VLOM ratio has been developed by Mathuranath et al. (2007) after realizing that Alzheimer's patients have a tendency to perform better on verbal fluency (V) and language (L) subtest while the patients with fronto-temporal dementia usually obtain a relatively higher score in orientation (O) and memory (M) tasks what has been also confirmed by several other studies. Calculating of the ratio $(V+L) / (O+M)$ enables the practitioners to fairly accurately distinguish between Alzheimer's disease (AD) and fronto-temporal dementia (FTD) in patients (Mathuranath et al., 2007). The VLOM ratio of > 3.2 , with sensitivity of 74% and specificity of 85%, can distinguish people with AD from people with non-AD and VLOM of < 2.2 (sensitivity of 58%, specificity of 95%) refers to an impairment in language and verbal fluency what differentiate individuals with FTD from ones with non-FTD (Mioshi et al., 2006).

1.4.3. Findings of the ACE-R validation studies

It is, however, important to bear in mind that several validation studies report the influence of some demographic characteristics of patient on ACE-R score. Higher education and lower age seem to be associated with higher score. No gender differences have been observed (Konstantinopoulou et al., 2011).

Despite this deficiency, which is actually present in most of the cognitive tests, ACE-R is considered an excellent tool for detection of mild dementia and differential diagnosis respectively. Research and clinical experience have supported its diagnostic accuracy, practicality and also the fact that ACE-R seems to be the best single predictor of patient's progression to dementia nowadays (Kwak et al., 2010).

The ACE-R is, however, a relatively new testing method and not as widely studied and used as its original version ACE. Even though the countries which currently use their own version of ACE-R report its benefits, there is still need to test this tool across the world and adapt it cross-culturally (Carvalho et al., 2012). Despite its many positives, ACE-R has been so far clinically used mainly by English speaking or developed countries where the proportion of older population is increasing the most rapidly. However, as already mentioned, according to recent studies it is expected that around the year 2050 the proportion of older people in less developed countries of e.g. Eastern or Central Europe will be approximately the same than in developed countries such as Western Europe (Uhlenberg, 2009). It is therefore of a great importance to develop an appropriate tool which could be applied widely across the world and the ACE-R seems to be a promising test for meeting this goal.

1.5.Aims of the current study

For this reason, the current research project attempts to assess people from the country of post-communist bloc, namely Slovakia, using the Slovak version of Addenbrooke's Cognitive Examination-Revised (ACE-R).

Slovakia (see Table 1) currently lacks a valid neuropsychological assessment for dementia diagnosis. The most widely used test is the MMSE which is also the only test that doctors consider when prescribing the drugs or suggest the appropriate therapy for the patients. The MOCA has its Slovak version as well but it is not as widely spread as the MMSE. However, neither of these tools has been properly studied, validated and adapted on the Slovak population. They have rather been simply taken from well-adapted versions in the Czech Republic which is culturally and linguistically very similar to Slovakia.

The aim of this study was, therefore, to investigate the performance of cognitively healthy elderly and dementia patients on the Slovak version of ACE-R. It was also attempted to evaluate the diagnostic accuracy of the test and compare it with the MMSE.

It is expected that the Slovak ACE-R, after proving its benefits, will become a common and acceptable neuropsychological tool in the country. It is also believed that running the test in a country of Central Europe would provide valuable information enabling to assess ACE-R's generalizability, cross-cultural adaptability and possibly suggest its further improvements.

Table 1*Basic Characteristics of Slovakia*

SLOVAKIA
Population - 5,444, 325 (2011)
Area - 49,035 km ² (18,932 sq mi)
Capital (largest city) - Bratislava (462,603)
Official language - Slovak
Educational system - Primary School (9 years)
High School (4-5 years)
University(3ys BcHon, 2ys Msc)
PhD (3 years)
Member state of - European Union, NATO, United Nations, OECD, WTO
Part of Czechoslovakia until 1 st of January 1993, then independent state
Cognitive tests used at the moment- MMSE, MoCA
Source: Slovakia, the Guide to the Slovak Republic 2011

2 METHODS**2.1. The Instrument**

The ACE-R test and also Guide of instructions was translated into Slovak from the original English version and also already adapted Czech one. There is a very close relationship between Slovakia and the Czech Republic. The two countries have a common historical and cultural background as they constituted one state for a long time and despite their split two decades ago, they still cooperate very closely in many fields and are exposed to similar cultural influences. The languages are also very similar and even now most of the people in both countries are considered passive bilinguals since they understand but do not actively use the other language in daily life. Czech ACE-R has, therefore, represented a great help when creating the Slovak adaptation, especially when making changes in language subtest or tasks which had to be culturally adapted. In addition, some problematic parts of the test were directly consulted via e-mail communication with authors of the Czech version who were the psychiatrists, psychologists and linguists.

When the Slovak version of the ACE-R translated from the English original had been made, a Slovak-English bilingual being an expert in European cultural studies and International relations was asked to make a back translation from Slovak to English.

This person was considered suitable for a given task since was a cross-cultural specialist and at the same time was not familiar with the original ACE-R. The original English version was shown to be very similar to the back-translated one, therefore only minor changes, especially in the instruction part were made.

A pilot study was thereafter run in order to check the clarity and comprehensibility of the tasks and to obtain the opportunity to make further changes according to that practical trial. There were 10 cognitively healthy participants of age range 60-70 who were tested with Slovak ACE-R which included several possible alternatives in some tasks. Afterwards the participants were asked for a feedback especially on the questions where more possibilities were considered to be used in the final version. Few changes were made accordingly.

2.1.1. Adaptations and changes in the Slovak ACE-R

Some adaptations concerning subtests attention and orientation, memory and language were made. We also adjusted the test design (Appendix D).

Subtest Attention and orientation

In the “Attention and concentration task” where patient is asked to spell the word “WORLD” backwards, two word alternatives of the same letter structure (consonant, vowel, consonant, consonant, consonant) were considered. They were “POKRM” (meal or repast) which is used in the Czech version and “STROM” (tree). Since “POKRM” is rather formal and infrequently used word in Slovak we decided to use the word “STROM” in the final version. Direct translation of the word “WORLD” (“SVET” in the Slovak language) was not possible in this case because it did not correspond to the difficulty level of the original.

Subtest Memory

The “Anterograde memory task”, where patient is asked to learn and remember the name and address, was modified in order to be consistent with the Slovak system.

The “Retrograde memory task”, where there are four questions assessing patient’s memory for the important world and domestic events were partly replaced.

Since the current political situation in the Slovak government is rather turbulent the question “Who is the current Prime Minister” was replaced by “Who is the current president of Slovakia?”. Presidential post is relatively stable therefore this choice seemed to be more appropriate and less confusing.

Two options were considered for the question related to the important domestic event from the past. They were “Who was the first president of Czechoslovakia after the Velvet revolution in 1989?” and “What was the name of a student who committed suicide by self-immolation as a protest against the occupation of Czechoslovakia in 1969?”. Both these events are connected to revolutionary times of the country, therefore expected to be very well known what was also confirmed in the pilot study. After consultations with the Czech and Slovak colleagues it was decided to use the first option and asked about the president. The second option was not recommended since it was considered rather difficult and also sensitive for some people. The questions possibly causing distress or negative emotions in patients (e.g. Second World War, religious questions, etc.) were advised to be avoided.

The question “What is name of the USA president?” asking for current world affairs was kept. The question “Name of the USA president who was assassinated in the 1960's” was, however, replaced by “Can you, remember the date of terrorist attack on the twin towers of World trade centre in New York?”. Even though this event happened only a decade ago and does not completely correspond to the original version, it was considered to be an appropriate option to use in the Slovak ACE-R. The tragic event of 11th September is very well-known world-wide and has become a part of general knowledge. For this reason, this option seemed to be an adequate choice regarding also the future use of the test for people who are middle-aged at the moment.

Subtest Language

In the “Language-Repetition task” two words could be directly translated from the English original (unintelligible and statistician) but other two had to be adapted in order to preserve the number of syllables and also the level of difficulty of articulation and phonology. The sentences were only slightly adjusted.

“Language-reading task” was certainly the most challenging item to be modified and adapted for the Slovak language. This task is designed to assess the individual’s knowledge of their native language rules. Patients are asked to read aloud five words which are read irregularly. Since irregular reading is very typical for the English language and is not present in Slovak or many other languages, several possibilities had to be considered in order to find an appropriate alternative. After e-mail discussion with authors of the Czech ACE-R a group of words which might represent an equivalent for the English version was chosen. Several English words such as “weekend”, “pizza”, “shopping”, “jazz” which are commonly used in spoken language among the people

nowadays seemed to be a clever choice at first. However, they were not used in the final version, since the finding of the pilot study showed that the older generation, even the healthy individuals, might find it difficult to read in English.

Five purely Slovak words with irregular accentuation, mutation or other grammar exceptions were, therefore, chosen in the final version. These are commonly used in spoken and written language respectively and therefore should be well-known even among the elderly.

Subtest Verbal fluency and Visuo-spatial abilities

These subtests were kept intact with no changes in comparison to the original version.

2.2. Participants

Thirty-one patients with dementia and fifty-two healthy controls participated in this study. Comparison of number of participants in various adaptation of ACE-R across the world is provided in Table 2.

Patients were recruited at three different places in two Slovak cities (Bratislava- the capital, Banská Bystrica- the greatest town of central Slovakia) and healthy controls at different places across the Western and Central Slovakia.

Clients of Memory Centre in Bratislava were either cognitively healthy seniors who regularly participated at cognitive trainings organised by this organisation or Alzheimer's patients participating at daily activities there. Several of their cognitively healthy family members were also willing to participate in the current study. Therefore both cognitively healthy elderly and Alzheimer's patients were recruited in this centre.

The elderly living in Hestia care home in Bratislava were also assessed. All tested participants there had dementia of different stages.

In the Centre of social services for the elderly in Banská Bystrica the recruited participants were patients of different dementia stages who regularly participated at daily activities provided by this centre and also their cognitively healthy relatives.

Other controls were recruited variously through senior clubs, family and friends.

Table 2

Adaptations of ACE-R in some Countries of the World
(numbers of people in control group and patient group)

	CONTROLS	PATIENTS
GERMANY ¹	54	26
DENMARK ²	72	70
GREECE ³	63	78
BRAZIL ⁴	62	31
KOREA ⁵	84	72
JAPAN ⁶	62	74
SLOVAKIA	52	31

Sources: 1. Alexopoulos et al., 2006, 2. Stokholm et al., 2009,
3. Konstantinopoulou et al., 2011, 4. Carvalho et al., 2010,
5. Kwak et al., 2010, 6. Yoshida et al., 2009

2.2.1. Patients

Patient group in this study was rather heterogeneous regarding the type and duration of dementia due to the following reasons.

In some cases, patients' anamnesis was not available, due to confidentiality, what disabled us from obtaining detailed information about the case. Another problem in recruiting the patients was caused by the inconsistencies of dementia diagnosis in Slovakia. As already mentioned, the differential diagnosis in the country is rather problematic and practically does not exist at the moment. The patients are usually diagnosed either with general dementia or dementia of Alzheimer's type and no further differentiation is provided. It was, therefore, not possible to distinguish patients based either on different dementia types or on duration of disease.

All patients in the current study were, however, examined by a team of specialists, underwent several medical or psychological assessments and were treated for dementia. They were, therefore, classified into dementia group of this study.

Exclusion criteria for the patient group were a significant psychiatric disorder (e.g. schizophrenia or depression) and causes of dementia other than neurodegenerative processes (e.g. head injury, alcoholism, drug abuse, etc.).

2.2.2.Controls

The healthy control group was composed of cognitively healthy elderly over the age of 63. All subjects were self-sufficient, had a normal functioning in their daily living and none complained about memory or other cognitive problems at the time of testing.

Demographic characteristic of both patients and controls are reported in Table 3.

All subjects or their relatives were provided with either written or oral explanation of the purpose of the study. Testing was also approved by the directors of given organisations where the data was collected what was in compliance with Slovak standards and ethical code.

Table 3 *Demographic Characteristics of the Control Group and Patients*

	CONTROLS		PATIENTS	
Number of Participants	52		31	
Age Range	63-83		63-87	
Mean of Age	71.2		77.7	
Gender	females- 36	males- 16	females- 24	males- 7
Mean of yrs of Education	14.44		13.57	

2.3. Procedure

All subjects were assessed individually in one-to-one contact. Both the controls and patients were able to understand the instructions and complete the test. There was no time limit for test completing but its administration took approximately 15-20 minutes for healthy individuals, whereas in patients the time varied from 20 to 40 minutes. The testing time of 40 minutes was, however, required only in two patients with severe dementia both tested in the Centre of social services for the elderly in Banská Bystrica.

The participants were provided with a sheet of paper, pencil and rubber so they had a possibility to correct themselves in drawing or writing tasks.

All stimuli (such as pictures, words or instructions) subjects were supposed to look at, read or manipulate with were clearly printed on a big format so that the individuals with vision problems did not have difficulties in completing the tasks.

In the language naming task real objects were used instead of their picture representations for the first two stimuli (pencil and watch) what was suggested by the Czech adaptation.

A mobile phone with stopwatch was used for measuring one minute in verbal fluency task.

2.4. Statistical analysis

Statistical analysis was computed using R-studio version 2.14.0 and SPSS Statistics 19. Demographic characteristics, the Slovak ACE-R total score and subscores were compared between patients and controls using independent Student's t-test. Reliability of the test was calculated using Cronbach's alpha coefficient. The Spearman correlation coefficient was calculated in order to assess the convergent and concurrent validity of the Slovak ACE-R comparing it to the MMSE. The receiver operating curve (ROC) was computed in order to define the sensitivity and specificity at different cut-off scores. The area under the curve was calculated in order to see the accuracy of the Slovak ACE-R which was also furthermore compared to the MMSE.

3 RESULTS

3.1.Characteristics of the sample

The comparison of healthy and patient group was first conducted in order to see if they differed in gender, age and number of years they attended school what was important information when drawing conclusions. Independent Student's t-test was used for a mean comparison of age and years of education between groups while Chi square was calculated in order to see the proportion of female and male participants in both groups. The results revealed no statistically significant differences in these three socio-demographic parameters namely gender ($\chi^2=1.29$, $df=1$, $p> 0.05$), age ($t(81)=5.39$, $p> 0.05$) and years of education ($t(80)=0.93$, $p> 0.05$) between the controls and patient group.

3.2.Test performance in patients

As expected, patients' overall score achieved on the Slovak ACE-R was markedly lower than the overall score of the controls which also reached the statistically significant value ($t(81)= 14.03$, $p< 0.05$). The score range in a cognitively healthy individual varied from 74-98 with the mean of 90.38 while in the patient group it varied from 11- 80 with the mean of 53.87 (Appendix C).

Significantly impaired performance was shown on all five subtests in the patient group in comparison with the healthy group. The results of the independent Student's t-test were as follows - *Orientation and Attention* ($t(81)= 8.93$, $p< 0.05$), *Memory* ($t(81)=$

15.89, $p < 0.05$), *Verbal Fluency* ($t(81) = 10.47$, $p < 0.05$), *Language* ($t(81) = 7.98$, $p < 0.05$), *Visuo-spatial abilities* ($t(81) = 8.21$, $p < 0.05$). The score range, mean, standard deviation (SD) and mean-2SD of all subtests are reported in Table 4 for the controls and for the patients.

Table 4

Patient and Control Group- Score Range, Mean, Standard Deviation (SD), Mean minus 2SD of the Slovak ACE-R and Subtests

TEST/SUBTEST	ACE-R SCORE RANGE	MEAN	SD	MEAN- 2SD
Patient group				
ACE-R total	11-80/100	53.17	16.57	20.03
Orientation	0-17 /18	11.77	4.47	2.83
Memory	0-17 /26	7.90	4.46	-1.02
V. Fluency	0-11 /14	4.63	3.13	-1.63
Language	8-26 /26	18.07	4.79	8.49
Visuo-Spatial A.	2-16 /16	10.87	4.06	2.75
Control group				
ACE-R total	74-98/100	90.40	6.62	77.16
Orientation	16-18 /18	17.58	0.67	16.34
Memory	13-26 /26	21.69	3.13	15.43
V. Fluency	5-14 /14	11.35	2.27	6.81
Language	16-26 /26	24.27	2.27	19.73
Visuo-Spatial A.	13-16 /16	15.5	0.75	14

3.3.Participant with a borderline score

The score overlap between the controls and participants was also analysed. This “borderline group” was composed of participants obtaining an overall score between 74 and 80. There were 5 such cases in the healthy group and 5 in the patient group. The description of these 10 cases regarding their age, gender, educational level, place of living and obtained scores on all ACE-R subtests is shown in Table 5 (Appendix A).

3.4.Effect of age, gender and education on the ACE-R performance

Since several adaptations of ACE-R, Czech version included, reported the effect of age and years of education on test performance, the current study also aimed to examine if the same effect was present in the Slovak adaptation.

The general linear model (glm) was used in order to see the influence of age, education and gender on achieved score in the controls. The healthy group was divided into three levels according to their achieved education and these were “Basic Education”, “High School Education” and “Advanced Education”. Based on age, participants were levelled into three groups “Age group sixties”, “Age group seventies” and “Age group eighties”. Gender was simply divided into “females” and “males”.

Age and education were shown to significantly influence the test performance while there was no significant difference between sexes in the obtained score. A significantly different performance was observed between all three age groups where the obtained score tended to decrease with age. A similar effect was also observed in the three education levels where participants with low education performed significantly lower than participants with high and advanced education, and highly educated people achieved a lower score than advanced educated individuals.

3.5. Reliability and validity of the Slovak ACE-R

The internal consistency of the total ACE-R score was measured calculating the Cronbach’s alpha coefficient obtaining an excellent result of 0.9.

The Spearman correlation coefficient was calculated in order to assess the convergent and concurrent validity of the Slovak ACE-R. The scale was correlated with the MMSE obtaining strong positive correlation between the two tests ($r = 0.896$, $p < 0.05$). This result is understandable since, as already mentioned, the MMSE is part of ACE-R and both tests are designed to assess the cognitive deterioration.

3.6. Cut-off scores

Several possible cut-off scores were estimated based on different methods. The Czech version of ACE-R kept the cut-offs from the original study (Mathurananth et al., 2004) which were set for 88 and 83. 88 represented the mean of score minus 2SDs in the original study and 83 was statistically estimated from the clinical data and represented very probable presence of dementia. Sensitivity and specificity of these two cut-off scores in the Slovak ACE-R was, therefore, also assessed. Another cut-off score assessed in present study was 85/86 which was chosen in several other adaptations (e.g. Germany or Denmark), also 77 which represented the mean minus 2SDs in the controls’ score and finally 74 which was the lowest score obtained in the healthy group of current study.

A cut-off score of 83 yielded the sensitivity of 85% and specificity of 100%, cut-off 85/86 had also optimal sensitivity (81%) and specificity (100%). Sensitivity of the score 77 was 94% while specificity was 90%, and 88 had the sensitivity of 75% and specificity of 100%. The lowest obtained score of the controls 74 had the sensitivity of 96% and specificity of 84%. Specificity and sensitivity at different cut-off scores from 70 to 86 is reported in Table 6.

The cut-off scores of individual subtests and their comparison with the original English ACE-R were also assessed. The alternative cut-offs of the Slovak ACE-R subtests with the highest sensitivity and specificity are reported in Table 7.

Table 6
Sensitivity and Specificity at Different Cut-off Scores between 70- 86 of the Slovak ACE-R

Cut-off	Sensitivity	Specificity
71/72	100%	80%
73	100%	84%
74/75	96%	87%
76	96%	90%
77	94%	90%
78/79	90%	93%
79/80	90%	97%
80	90%	100%
81/82	86%	100%
82/83	85%	100%
84	83%	100%
85/86	80%	100%

Table 7

Cut-off Scores (mean – 2SDs) of the Slovak ACE-R Subtests with their Sensitivity, Specificity and the Cut-offs from the Original English ACE-R

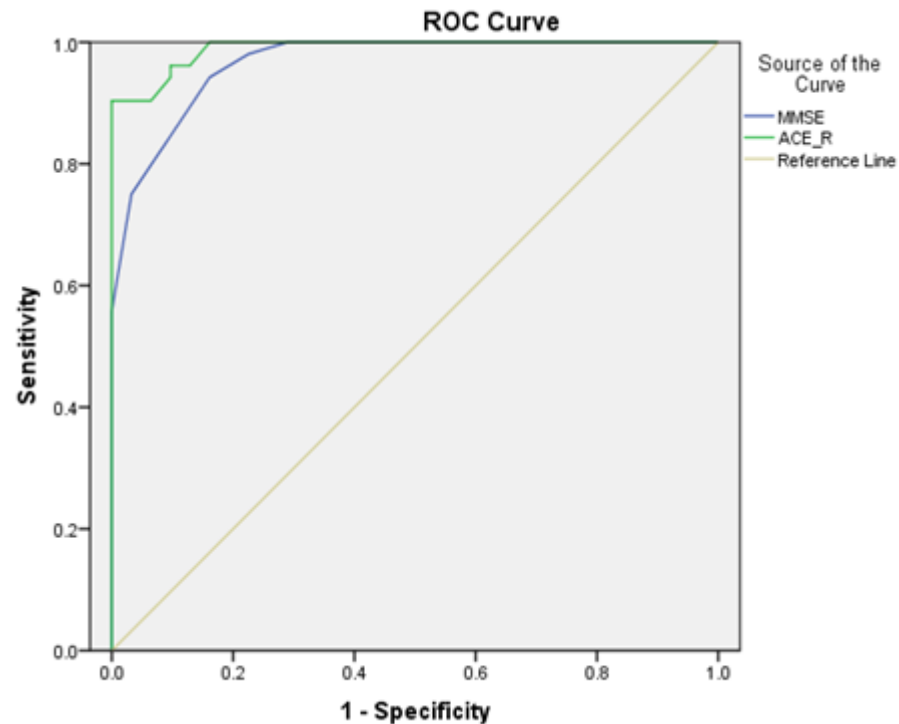
ACE-R SUBTEST	MEAN- 2 SD (max.score)	SENSITIVITY, SPECIFICITY	CUT-OFFS of the ENGLISH ACE-R
Attention/Orientation	16/17 (18)	(90%, 90%)	17
Memory	17/18 (26)	(100%, 92%)	18
Verbal Fluency	8/9 (14)	(81%, 87%)	10
Language	24/25 (26)	(90%, 65%)	24
Visuo-spatial abilit.	15/16 (16)	(90%, 64%)	15

Mild cognitive impairment (MCI) is, according to Mioshi (2006), represented in ACE-R by approximately a value 1.5SD below the mean of overall score (Mioshi et al., 2006). In the Slovak ACE-R this score is 80 with sensitivity of 90% and specificity of 100%. According to the estimated sensitivity and specificity of several alternative cut-offs, it is suggested to accept the cut-off scores of the value of 80 for MCI and 77 for dementia in the Slovak ACE-R since these were shown to be the most accurate.

3.7.Diagnostic accuracy of the Slovak ACE-R

To identify the sensitivity and specificity at different cut-offs mentioned above the receiver operating characteristics (ROC) analysis was performed. The same statistical technique was used for assessing the accuracy of overall Slovak ACE-R, for all five subtests separately and also for the comparison of the ACE-R with the MMSE. The area under ROC curve (AUC) of the ACE-R was 0.989 what suggests excellent diagnostic accuracy of the test. The AUC of MMSE was slightly lower, 0.966, but still represented a very good accuracy of the test. Comparison of ROC curve of both tests is shown in Fig.1. The AUC values of the five subtests of the Slovak ACE-R were as follows - *Attention and orientation* 0.975, *Memory* 0.992, *Verbal fluency* 0.928, *Language* 0.876, *Visuo-spatial abilities* 0.908. Four Slovak ACE-R subtests seem to have an excellent diagnostic accuracy and subtest Language good accuracy.

Fig.1 ROC Curve - Comparison of the Slovak ACE-R and the MMSE



3.8. Patient group

Since the differential diagnosis in Slovakia is not widely used in practise and dementia patients with various cognitive impairments are usually diagnosed with “general dementia” or “dementia of Alzheimer’s type”, it was not possible to clearly distinguish patients according to the different dementia types. In addition, as already mentioned, no detailed patients’ anamnesis was provided for all cases when collecting the data what disabled us to at least evaluate the severity and level of their impairment in specific cognitive domain. As a result, the data-driven analysis was used, where the possible diagnosis was tried to be estimated according to the most impaired cognitive domains in patients. Patients were considered mildly impaired on a specific cognitive domain when their achieved score was lower than a mean - 2SDs in the given subtest of the controls. Severe impairment was represented by a mean of score - 3SDs of the specific subtest in the healthy group.

According to the division in the Table 8 (Appendix B), patients were the most impaired on memory and verbal fluency and performed rather poorly on other three subtests. Language seems to be the most preserved cognitive domain in patients of current study.

4 DISCUSSION

The Addenbrooke's Cognitive Examination-revised (ACE-R) is a relatively new dementia screening test but its benefits have already been confirmed by several adaptation studies worldwide (Komadina et al., 2011). However, the test is not widely used in the post-communist region and therefore the main aim of the current study was to translate and adapt the ACE-R into Slovak and evaluate its usefulness and accuracy in the elderly population of the country. The present study also attempted to compare its psychometric properties with the MMSE and prove its advantage over this almost exclusively used dementia screening tool in Slovakia.

4.1. Diagnostic accuracy

The Cronbach's alpha of the value 0.9 showed an excellent internal consistency of the Slovak ACE-R. The findings from the current study also confirmed the influence of age and educational level of the participants on the ACE-R performance what had been previously found also in several other adaptations (Raisová et al., 2011).

The AUC value of 0.989 showed that the Slovak ACE-R has an excellent diagnostic accuracy in differentiating between cognitively healthy elderly and patients with some cognitive impairment. This finding proved that the Slovak ACE-R seems to be a more accurate dementia screening tool in comparison with the MMSE. The diagnostic accuracy of the MMSE was also excellent but of lower AUC value equal to 0.966.

The attempt of the current study was also to assess the diagnostic accuracy of all five subtests separately in order to see how the test works in impairment detection of specific cognitive domains. Diagnostic accuracy was shown to be excellent in all ACE-R subtests, except for the subtest assessing language abilities where the accuracy was found to be good. This slightly worse accuracy of the language part might be caused by several insufficiencies which might have emerged when translating the test from the original version. It is assumed that several language tasks might have been problematic in the Slovak ACE-R adaptation.

Language subtest

As already mentioned, "the language reading task" was probably the most challenging task to translate in the Slovak ACE-R version since there is no irregular reading in the Slovak language. This item, therefore, might not adequately assess what is meant to be

assessed in the original English version. The fact that some of the chosen words of this task were problematic was evident also during the actual participants' testing.

A ceiling effect was observed in reading of words "obyčajní" and "vážnica" since all participants were able to read them correctly. The word "vinná" was shown to be appropriate for the task. Although the stress putting on "nn", which was the key part of the word, was in some cases difficult to assess properly since the difference between the correct and incorrect pronunciation was often minor. Therefore, it is suggested considering other words which had been examined before completing the final version in order to see their possible better suitability for this task.

Another language item which appeared to be problematic during the actual data collection was the "picture naming task" and "language-comprehension task". Since the Czech adaptation, which was followed to some extent when making the Slovak version, did not make any changes in the picture stimuli in comparison to the original ACE-R, all original 12 pictures were also kept in the Slovak adaptation. It has been, however, proven that in the "language-comprehension task" there are multiple answers possible in the questions "Point to the picture which is associated with the monarchy" and "Point to the picture which has a nautical connection". The only acceptable option for the picture connected to monarchy is, according to the original instructions, the crown but several participants of the present study pointed also to the harp. This musical instrument used to be widely used on the royal courts in the past and it still symbolizes the life in a castle in movies or books about the history of Slovakia what might be the reason why harp evoked the monarchy in some participants.

The anchor is supposed to be the exclusive picture with a nautical connection, but a great number of participants also pointed to the barrel and accordion since these objects are strongly associated with the lifestyle of sailors. Since the Czech adaptation accepts all the three answers as correct, the participants of the current study were also awarded a point for pointing to one of three mentioned pictures. However, the possibility of multiple answers might be problematic. The fact that there was not clearly defined the correct answer in the task might have negatively affected the diagnostic accuracy of the overall language subtest. It is, therefore, strongly recommended using an appropriate alternative for mentioned picture stimuli allowing solely one unambiguous answer in the further revision of the Slovak ACE-R.

4.2.Cut-off scores

Regarding the cut-off scores for dementia and MCI, the current study attempted to estimate the sensitivity and specificity of several ones in the Slovak ACE-R which were chosen according to the original study and other European countries' validations. The most optimal sensitivity and specificity had the value of 77 (94%,90%) representing the mean of overall score minus 2SDs in the controls of the current study and 80 (90%,100%) representing the mean minus 1.5SDs. The values, 80 for MCI and 77 for dementia, are, therefore suggested to be cut-off points for the Slovak population.

In comparison to the original English version or several other studies the cut-off scores of the Slovak ACE-R were lower and did not match exactly the previously proposed ones. This fact might be caused by the difference between the participant groups of current and other studies in relation to the severity and type of dementia, average age, educational level or socio-cultural background (Alexopoulos et al., 2006). All mentioned factors might have significantly influenced the cognitive functioning of the elderly of the present study and caused the difference in optimal cut-off scores of the Slovak ACE-R.

Another possible explanation for this inconsistency in cut-off points might be also the fact that several changes had to be made while adapting the test for Slovakia. This might have caused that the level of difficulty of some items was higher than in the original version, therefore the controls of the current study achieved a lower score on average.

4.2.1.Partial cut-off scores

Attention and orientation

According to the findings from partial cut-offs of the current study it can be seen that in the first three parts (Attention and orientation, Memory and Verbal Fluency) the cut-off scores of the Slovak version are one point lower than in the original English ACE-R. The reasons might be as follows.

In the Attention and Orientation subtest, Slovak participants might have found the task "Attention and Concentration" rather difficult as they were asked to spell the word "STROM" (tree) backwards. The spelling of words is very common for English speakers who are asked to do so on almost a daily basis due to irregular writing. In Slovakia, however, spelling is rather infrequent and people are not familiar with the concept to such an extent. As a result, this task might have been more challenging for the Slovak population than for the English speakers. The participants of the current

study might have, therefore, generally performed worse on the task what might have affected lower cut-off in the Attention and Orientation subtest.

Memory

The items in the Memory subtest which might have been more problematic in the Slovak version compared to the original were “Anterograde memory task” and “Retrograde memory task”.

In the question assessing the anterograde memory it was attempted to adjust the address which is supposed to be remembered by the participants and to find an appropriate alternative to the English ACE-R. This name and address was supposed to represent a typical Slovak address and at the same time a correct answer was supposed to be awarded 7 points like in the original version. The structure of the address was kept similar to the English original except for the county which is not part of a traditional address in Slovakia. Instead of this item the name of a district was used. The district is more often mentioned in the address, especially on formal letters, although it is not always the case. The district “Západ” was chosen in the final version of the test since it seemed to be a fairly common district name used in several Slovak towns. The actual participant testing, however, revealed the peculiarity of this word. “Západ” means “West” in the Slovak language which caused confusion in some participants, especially in the patients, who had a tendency to mistake it for a cardinal direction. The fact that they did not understand the proper meaning of the word and usually its further explanation was needed, might have affected their worse performance on the task. It is therefore, suggested using a different name of district when making further improvements of the Slovak ACE-R version.

In the task assessing the retrograde memory there were two questions which appeared to be problematic for the participants. In the question “Who was the first president of Czechoslovakia after the Velvet revolution in 1989?” a number of participants had a tendency to mishear or ignore the second part of the question and answered “Thomas Garrigue Masaryk” who was the very first president of Czechoslovakia in 1918. It was therefore required to repeat and further explain the question very often. Several participants also asked for clear specification of the question since they found it controversial. The first president of Czechoslovakia straight after the Velvet revolution of 17th November was Gustáv Husák, still a communist, but he resigned on 10th December and Václav Havel (the right answer) was officially elected on 29th December

1989. Several participants, therefore, had doubts which one was meant in the question. Despite these insufficiencies it is suggested keeping this question in the memory task since the Czech ACE-R validation study reports its appropriateness (Bartoš et al., 2011). It is, however, necessary to transform the word order or structure of this question so that it is clear and unambiguous.

As assumed, another problematic item was the question “Can you remember the date of terrorist attack on the twin towers of World trade centre in New York?”. This question will be more appropriate for the future use of the Slovak ACE-R for people who are now in their 50s or 60s. However, a number of the older participants of the current study had difficulties with finding the correct answer.

Verbal Fluency

The studies investigating the cross-linguistic comparisons of verbal fluency are scarce but to some extent indicate the similar performance of participants across different languages (Pekalla et al., 2009). However, the study conducted by Kempler et al. (1998) comparing Vietnamese, Chinese, Hispanic and English speakers revealed that language differences might have effect on verbal fluency in participants. It was found that the Spanish speakers generated the fewest words in category fluency task (animals) while the Vietnamese produced the most. The difference was attributed to the fact that the names of animals in Spanish were the longest while Vietnamese ones the shortest among the languages in the study (Kempler et al., 1998). Moreover, there is an evidence that the speakers of different languages tend to use different cognitive strategies when producing words (Roselli et al., 2002). The worse performance of the participants in current study resulting in the lower cut-off score of the verbal fluency task might have been, therefore, affected by the language differences between Slovak and English. Further investigation of this possibility is, however, required.

The lower cut-off score in comparison to the original version might also be attributed to different age range and education level of the participants in the original and present study. There is an evidence that age and education affect the performance on the verbal fluency task. Phonemic verbal fluency seems to be more sensitive to influence of education while age tends to affect more the categorical verbal fluency (Tombaugh et al., 1999).

4.3. Patient group

As already mentioned in the methods, the patient group of the current study was rather heterogeneous. In several patients the type of dementia was not clearly specified what disabled us from predicting the patients' performance on different subtests. The attempt of the current study, therefore, also was to identify the locus of the impairment in the specific cognitive domain using the data-driven analysis. Patients in general performed the most poorly on memory and verbal fluency task. 26 participants out of the total of 31 were impaired in both of these cognitive domains, 16 of which severely. The statistical analysis also showed the negative value of mean minus 2SD only in these two ACE-R subtests. These findings might suggest that the majority of the patient group was composed of Alzheimer's patients with a prominent memory deficit and of patients with fronto-temporal dementia who tend to perform worse on verbal fluency task (Mathuranath et al., 2007). The patients with a disorder where the language problems are primary, such as semantic dementia or primary progressive aphasia, were rare in the present study.

Another possible reason for these findings might be the heterogeneity of the patient group. Since there was no information about the severity and length of dementia in most cases of the current study, the patients' level of impairment might have varied to a great extent and caused skewness of the patient data. In addition, since the subtests assessing the memory and verbal fluency seem to be most used, developed and accurate in detection of early cognitive impairment, they might have detected even a slight deficit in the patients what other subtests were not able to (De Jager et al., 2003). The patients' performance was therefore generally worse on these two subtests and also greatly varied which affected their lower mean and further negative value of mean minus 2SD.

The patients' worse performance on specifically verbal fluency subtest might have been also caused by already mentioned reasons (see 4.2.1. Partial cut-off scores- *Verbal Fluency*).

4.4. Participants with a borderline score

There were 10 participants (5 healthy and 5 patients) with a borderline score, ranging from 74 to 80 in the current study. The further analysis was conducted in order to see what might have affected the poor performance of the healthy individuals and exceptionally high score in patients on the other side.

There were probably several reasons for obtaining the lower score in the controls; therefore an individual analysis of these cases is required. The performance of a healthy

participant (age of 81, education - 17 years, county - BB, ACE-R - 74) might have been caused by her age but since she is highly educated, we assume that the ACE-R might have detected some early cognitive impairment in her.

Another participant's performance from the control group (age of 74, education - 9 years, county - LV, ACE-R - 77) was probably affected by her low level of education since she finished only compulsory education. The lower score of the other three healthy controls might have been affected again by their age (79, 83, 83), years they attended school (12, 10, 12) which represented lower or high school education but it might have also equally indicated an early stage of cognitive decline.

Regarding the patient group, it is assumed that their very good performance on the test might have been affected by the fact that they all were regular clients of the Memory centre in Bratislava. This centre is one of a kind in Slovakia and can be described as a highly modern institution taking care of dementia patients of different stages using various therapeutic methods. Its clients attend cognitive trainings and a wide range of other different activities that stimulate them mentally, physically and also socially. The patients might also have been familiar with some items of the ACE-R since very similar tasks are often used in mental trainings. Another possible explanation might be, especially for the patients over 80, that the participants were misclassified for patients and in reality the cause of their cognitive deficit is a normal process of cognitive decline coming with growing old.

4.5.Limitations

The current study has several limitations which should be acknowledged. Participant group was rather homogeneous regarding the place of residence. All participants were coming from the Western and Central region of the country. Since the Eastern part is considered as economically least developed region of Slovakia, it would be meaningful to collect data also in this area in a future study so that the results are more representative for the overall Slovak population.

The data collection in the further studies might also be expanded in obtaining more information about the participants' social and economic background. There is some evidence that specific kinds of mental or physical leisure activities and socially engaged lifestyle might help people maintain their mental health and positively affect cognitive decline in the elderly (Wang et al., 2002).

The analysis of these variables and their effect on the performance on the ACE-R in Slovak population might be therefore also the part of further improvements.

As already highlighted, a great limitation of the current study regarding the participants was the patient group. For already mentioned reasons, this group was rather heterogeneous regarding the diagnosis and also the stage of dementia since it was not possible to divide patients according to the specific dementia type and duration of disease. This fact was greatly limiting when analysing the patient data since all patients had to be considered patients having simply “general dementia”. It was, therefore, not possible to analyse the performance on the ACE-R test from various perspectives, compare it across the different dementia types and stages and calculate the VLOM ratio. In order to properly assess the psychometric parameters of the Slovak ACE-R it is crucial to clearly distinguish dementia types and length of disease in patients in further validation studies of the Slovak ACE-R.

Another insufficiency of present study was the fact that the participants were not tested for depression or other affective disorders. Presence of such diseases in participants was the exclusion criterion in current study but we simply relied either on their subjective report (especially in the controls), consultancy with patient’s carer or medical records if provided. However, it might have happened that the subjective cognitive complaints of the participants from the patient group were misclassified as the onset of dementia while the actual reason was depression. It is well known that distinguishing between the patient with early stage of a degenerative disease and patient with depression is rather challenging for the clinicians (Stokholm et al., 2009). Exclusion of the participants of the current study according to the obtained score on a depression scale would have been therefore more suitable.

As can be seen, having better knowledge about the diagnosis as well as the presence of an affective disorder in the patients would have enabled to distinguish the participants more accurately. Moreover, it would have been also possible to conduct further statistical analysis in order to obtain results about the ACE-R performance specificities of the patients of different dementia and affective disorder types. Such information would have been meaningful since there is some evidence that ACE-R seems to be useful tool in differentiation between the early AD patients and people with depression. AD patients in early stages of the disease do not tend to show a global cognitive impairment while depression patients do (Stokholm et al., 2009). The centre of interest of the following studies using the Slovak version of ACE-R should be, inter alia, assessing of the performance across the dementia types and checking the possibilities of the differential diagnosis. Moreover, very few previous studies were interested in using

ACE-R in schizophrenics which is another area on which further studies using the Slovak version of ACE-R might focus (Hummelová-Fanfrdlová et al., 2006). Comparing the categorical and phonemic verbal fluency in participants might be also meaningful according to several studies stating the differences between them in dementia subtypes and healthy elderly (Henry et al., 2004).

Another possible insufficiency of the present study might have emerged when splitting the participants according to the years they attended school and determining their level of education obtained. Since the education of a number of the participants was interrupted by the Second World War and the post-war period when education was rather provisional and school system greatly differed from the current one in Slovakia, it was not always possible to clearly determine participants' education level. In several cases an appropriate equivalent best fitting the Slovak educational norms at the moment had to be found in order to be able to divide participants into groups and conduct the analysis. This might have caused an inaccuracy in the results, although minimal, since such adjustment of the education level was done in 6 cases only.

4.6. Conclusion

The aim of the current study was to translate and adapt the ACE-R for the Slovak population and also to assess the psychometric properties of this very first Slovak version. Despite several limitations of the study, the Slovak ACE-R might be considered useful and sensitive tool for dementia diagnosis based on results of statistical analysis. It was also shown to be better dementia screening instrument in comparison to the conventional MMSE. It is, therefore, believed that its further research and improvements will make it an accurate and valid method widely used for dementia diagnosis in Slovakia. The present study can also confirm the generalizability and cross-cultural adaptability of the ACE-R.

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APPENDICES

APPENDIX A

Table 5

Description of the Participants with a Borderline Score

<u>Age</u>	<u>Yrs of Educ</u>	<u>Sex</u>	<u>Coun ty*</u>	<u>ACE- R score (100)</u>	<u>MMSE score (30)</u>	<u>Attent. and Orient. (18)</u>	<u>Mem (26)</u>	<u>Verbal Fluen. (14)</u>	<u>Lang (26)</u>	<u>Visuo- Spatial Abb. (16)</u>
Controls										
81	17	F	BB	74	27	18	19	8	16	13
79	12	F	BB	78	26	16	17	8	21	16
83	10	M	BB	74	26	17	22	5	16	14
74	9	F	LV	77	26	17	14	6	24	16
83	12	F	BA	78	26	18	13	9	23	15
Patients										
76	15	F	BA	78	27	16	17	11	21	13
87	11	F	BA	75	28	17	16	12	20	10
80	20	M	BA	74	25	16	13	6	26	13
75	11	F	BA	80	27	17	13	11	23	16
72	13	F	BA	79	26	17	11	11	26	14

Notes: *County- BA- stands for Bratislava (the capital)

BB- Banská Bystrica (5th biggest town of Slovakia and centre of the Central Slovakia)

LV- Levice (small town in South Slovakia)

APPENDIX B

Table 8

Patient group: Severity of Impairment in Five Cognitive Domains

<u>AGE</u>	<u>Yrs. of educ.</u>	<u>ACE- R</u>	<u>MMSE</u>	<u>Attent. Orient.</u>	<u>Mem.</u>	<u>V.fluen.</u>	<u>Lang.</u>	<u>Vis.- sp.ab.</u>
79	12	11	4	XX	XX	XX	XX	XX
83	9	25	9	XX	XX	XX	XX	XX
80	13	35	15	XX	XX	XX	X	XX
87	8	35	13	XX	XX	XX	XX	XX
79	13	36	14	XX	XX	XX	XX	XX
81	8	38	15	XX	XX	XX	X	XX
75	20	41	14	XX	XX	X	XX	XX
84	12	41	20	XX	XX	XX	XX	XX
80	19	46	24	X	XX	XX		XX
84	18	46	21	X	XX	XX	X	XX
84	13	47	14	XX	XX	XX		XX
63	18	49	22	XX	XX	XX		XX
76	9	49	16	XX	XX	XX	X	X
75	8	50	16	XX	XX	XX	X	X
84	11	53	23	X	XX	X	X	XX
83	13	54	22	X	XX		X	XX
81	12	56	20	X	XX	XX	XX	
72	11	58	23	X	XX	XX	X	
77	18	58	21	XX	XX	X		X
79	13	58	22	XX	X	X	X	X
74	13	59	19	XX	X	XX		
76	9	61	23	XX	XX	X		X
72	20	64	26		XX	XX		
71	17	71	24	X	XX	X		
77	12	71	23	X	XX	X		
73	17	72	25	X	X	XX		
80	20	74	25		X	X		X
87	11	75	28			X		X
76	15	78	27					X
72	13	79	26		XX			
75	11	80	27		X			

Notes: X- mild impairment. Score lower than a mean-2SD for healthy group

XX- severe impairment. Score lower than a mean-3SD for healthy group

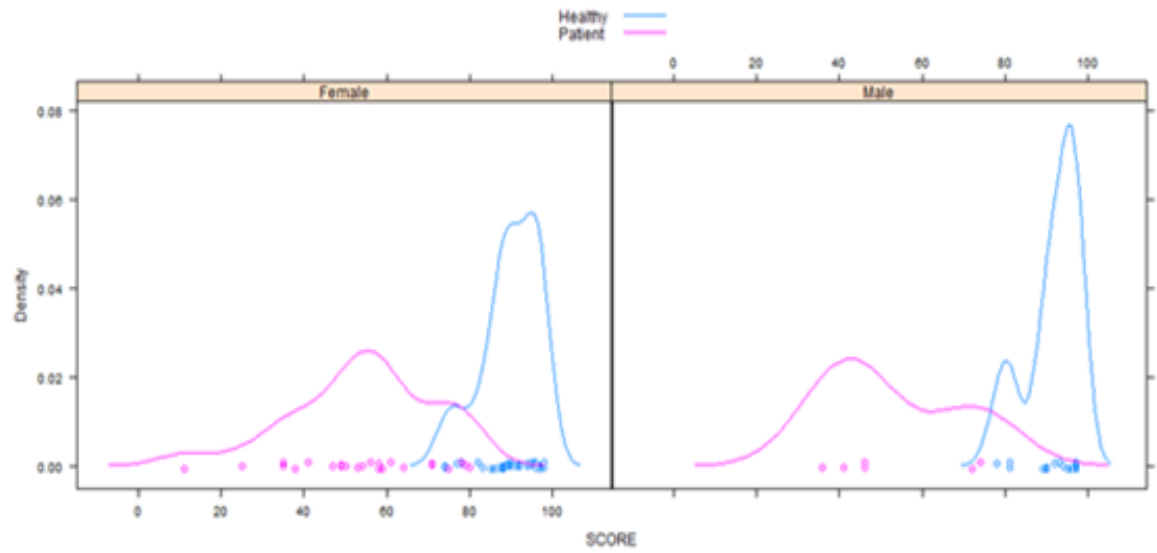
Years of education- =< 9 years represents basic education

9-14 years represent higher education (College, High School)

>14 years represent advanced education (University degree)

APPENDIX C

Fig 2 *Range of Obtained Test Score of the Patient and Healthy Group Divided by Gender*



APPENDIX D

ADDENBROOKSKÝ KOGNITÍVNY TEST (ACE-R)

(revidovaná verzia 2012)

Meno a priezvisko	<input type="text"/>	Administrátor	<input type="text"/>
Dátum narodenia	<input type="text"/>	Pracovná diagnóza	<input type="text"/>
Dĺžka vzdelania (roky)	<input type="text"/>	Lateralita	pravák <input type="checkbox"/> ľavák <input type="checkbox"/> ambidexter <input type="checkbox"/>
Dosiahnutý stupeň vzdelania	<input type="text"/>	DÁTUM VYŠETRENIA	<input type="text"/>

SUBSKÓRE		SKÓRE
Pozornosť a orientácia	/18	
Pamäť	/26	
Verbálna fluencia	/14	
Jazyk	/26	
Zrakovo-priestorové schopnosti	/16	
CELKOVÉ SKÓRE		SKÓRE
ACE-R	/100	
MMSE	/30	

1. ORIENTÁCIA		POZORNOSŤ A ORIENTÁCIA	
• Opýtajte sa pacienta/ky:			
1. Aký je dnes deň v týždni? <input type="text"/>	6. V akom štáte sa nachádzame? <input type="text"/>		Skóre (0-10) <input type="text"/>
2. Koľkého je dnes? <input type="text"/>	7. V akom meste sme? <input type="text"/>		
3. Ktorý je mesiac? <input type="text"/>	8. V ktorom kraji (oblasti) sa nachádzame? <input type="text"/>		
4. Ktorý je rok? <input type="text"/>	9. Ako sa volá táto budova/ nemocnica? <input type="text"/>		
5. Aké je ročné obdobie? <input type="text"/>	10. Na ktorom poschodí sa nachádzame? <input type="text"/>		
2. PAMÄŤ- ZAPAMÄTÁVANIE			POZORNOSŤ A ORIENTÁCIA
• Povedzte pacientovi/ke:			
„Teraz si ideme vyskúšať Vašu pamäť. Poviem Vám tri slová. Pokúste sa ich po mne zopakovať a zapamätať si ich. O chvíľu sa Vás na tieto slová opäť opýtam.“ (Ak je potrebné, slová zopakujte, maximálne však trikrát.)			
CITRÓN <input type="text"/>	KLÚČ <input type="text"/>		
LOPTA <input type="text"/>			

3. POZORNOSŤ A POČÍTANIE

• **Požiadajte pacienta/ku:**

“Teraz skúste odčítať 7 od čísla 100, čiže 100 mínus 7.” Po tom, ako pacient/ka odpovie, požiadajte ho/ju aby opäť odčítal/a 7 od zostatku a takto pokračoval/a pokiaľ nepoviete dosť. Odčítavanie zastavte, keď pacient/ka vykoná **operáciu 5x za sebou**.

100 → 93 86 79 72 65

Ak túto úlohu pacient/ka nedokáže bezchybne splniť, požiadajte ho/ju, aby vyhlásil/a nasledujúce slovo odzadu “STROM”

STROM (MORTS)

Skóre (0-5)

POZORNOSŤ

4. PAMÄŤ- VYBAVOVANIE

• **Povedzte pacientovi/ke:**

“Teraz si skúste spomenúť na 3 slová, ktoré ste mali pred chvíľou po mne opakovať a zapamätať si.”

CITRÓN KLÚČ LOPTA

Skóre (0-3)

5. PAMÄŤ- ANTEROGRÁDNA PAMÄŤ

• **Povedzte pacientovi/ke:**

„Teraz Vám poviem meno s adresou. Keď skončím, zopakujte, prosím, po mne všetky údaje. Takto to zopakujeme 3x, aby ste mali možnosť si to všetko dobre zapamätať. Na konci testu sa Vás na všetky údaje znovu opýtam.“

	1.Pokus	2.Pokus	3.Pokus
Ján Kováč
Majerská cesta 73
Žarnovica-Západ

Skóre (0-7)

PAMÄŤ

6. PAMÄŤ- RETROGRÁDNA PAMÄŤ

• **Opýtajte sa pacienta/ky:**

Kto je súčasným prezidentom Slovenskej Republiky?

Kto bol prvým prezidentom Československa po revolúcii v roku 1989?

Uveďte, prosím, deň a mesiac v ktorom padli dvojčiky Svetového obchodného centra v americkom New Yorku.

Kto je súčasným prezidentom Spojených štátov amerických?

Skóre (0-4)

7. SLOVNÁ PRODUKCIA- slová začínajúce na písmeno "P"

7a) Písmená

- *Povedzte pacientovi/ke:*

„Teraz Vám poviem písmeno abecedy a Vašou úlohou bude vymenovať čo najviac slov ktoré začínajú na toto písmeno. Nemôžu to však byť mená osôb ani miest a taktiež nemôžete menovať slová s rovnakým slovným základom (napríklad bývať, bývanie, bydlisko, obydlie atď.). Ste pripravený/á? Máte jednu minútu na to, aby ste vymenovali čo najviac slov, ktoré začínajú na písmeno "P". Teraz!“

Skóre (0-7)

Počet slov	Skóre
> 17	7
14-17	6
11-12	5
8-10	4
6-7	3
4-5	2
2-3	1
< 2	0

7b) Zvieratá

- *Povedzte pacientovi/ke:*

„Teraz bude Vašou úlohou vymenovať čo najviac zvierat, ktoré poznáte. Slová môžu začínať akýmkoľvek písmenom. Na túto úlohu máte opäť jednu minútu. Ste pripravený/á? Môžeme začať? Teraz!“

Skóre (0-7)

Počet slov	Skóre
> 17	7
14-17	6
11-1	5
8-10	4
6-7	3
4-5	2
2-3	1
< 2	0

VERBÁLNA FLUENCIA

8. JAZYK- POROZUMENIE

8a) Porozumenie písanej inštrukcii

- *Ukážte pacientovi/ke napísanú inštrukciu "Zatvorte oči!" a požiadajte ho/ju, aby príkaz vykonal/a. Inštrukciu neopakujte!*

„Prečítajte, prosím, tento pokyn a vykonajte ho. Ak potrebujete okuliare, tak si ich teraz nasadte.“

Skóre (0-1)

8b) 3-stupňový príkaz

- *Položte pred pacienta/ku papier a vyzvite ho/ju k nasledujúcej úlohe.*

„Teraz budete mať úlohu, ktorú si najprv vypočujete a až potom ju začnete plniť. Vezmite tento papier do pravej ruky. Preložte ho na polovicu. Položte ho na zem.“

Skóre (0-3)

JAZYK

9. JAZYK- PÍSANIE

- Dajte pacientovi/ke pero a "List pre pacienta/ku" a požiadajte ho/ju, aby napísal/a vetu. „Napíšte do tohto voľného priestoru akúkoľvek jednoduchú vetu, ktorá Vám napadne a ktorá dáva zmysel.“

Skóre (0-1)

10. JAZYK- OPAKOVANIE

- 10a • Požiadajte pacienta/ku:
„Opakujte po mne nasledujúce slová.“

chobotnica
produktivita
nezrozumiteľný
štatistika

Skóre (0-2)

- 10b • Požiadajte pacienta/ku:
„Zopakujte po mne nasledujúce vety.“

• „Hore, vzadu a dole.“

Skóre (0-1)

• „Je to tak a nie inak.“

Skóre (0-1)

11. JAZYK- POMENOVANIE OBRÁZKOV

- Použite "List pre pacienta/ku" a požiadajte ho/ju:
„Pomenujte, prosím, predmety na obrázkoch.“



Skóre(0-2)



Skóre(0-10)



12. JAZYK- POROZUMENIE

- Použite obrázky z "Listu pre pacienta/ku" z úlohy č.11 a opýtajte sa pacienta/ky:

Ukážte jeden obrázok, ktorý súvisí s kráľovstvom.
Ukážte jeden obrázok, na ktorom je vačkovec.
Ukážte jeden obrázok, ktorý súvisí s Antarktídou.
Ukážte jeden obrázok, ktorý súvisí s námorníctvom.

Skóre(0-4)

J A Z Y K

13. JAZYK- ČÍTANIE

- Použite „List pre pacienta/ku“ a požiadajte pacienta/ku:
„Teraz, prosím, nahlas prečítajte nasledujúce slová.“

OBYČAJNÍ, DCÉRA, JAZZ, VÄZNICA, HANBA

Skóre(0-1)

J A Z Y K

14. ZRAKOVO-PRIESTOROVÉ SCHOPNOSTI

14a) Prekrývajúce sa päťholníky

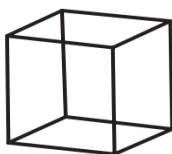
- Použite „List pre pacienta/ku“, dajte mu/jej ceruzku a požiadajte pacienta/ku:
„Nakreslite, prosím, obrázok čo najpresnejšie podľa predlohy.“



Skóre(0-1)

14b) Kocka

- Použite „List pre pacienta/ku“ a požiadajte pacienta/ku:
„Nakreslite, prosím, tento obrázok čo najpresnejšie podľa predlohy.“



Skóre(0-2)

14c) Hodiny

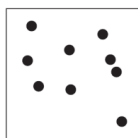
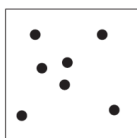
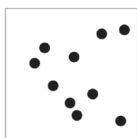
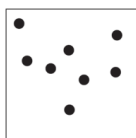
- Použite „List pre pacienta/ku“ a požiadajte pacienta/ku:
„Nakreslite, prosím, hodinový ciferník s číslicami.“ Keď pacient/ka túto časť úlohy skončí, požiadajte ho/ju, aby do hodín dokreslil/a ručičky, ktoré ukazujú na 5 hodín a 10 minút.

Skóre(0-5)

ZRAKOVO-PRIESTOROVÉ SCHOPNOSTI

15. PERCEPČNÉ SCHOPNOSTI

- Použite „List pre pacienta/ku“ a požiadajte pacienta/ku:
„Spočítajte, prosím, všetky bodky na obrázku bez toho, aby ste si na ne ukazovali.“



Skóre(0-4)

16. PERCEPČNÉ SCHOPNOSTI

- Použite „List pre pacienta/ku“ a požiadajte pacienta/ku:
„Prečítajte, prosím, nahlas nasledujúce písmená.“



Skóre(0-4)

17.VYBAVENIE SI ZAPAMÄTANÉHO (REPRODUKCIA)

- Požiadajte pacienta/ku:
„Teraz si, prosím, skúste spomenúť na meno a adresu, ktorú ste sa pred chvíľou učili a mali si zapamätať.“

Ján Kováč

.....

Majerská cesta 73

.....

Žarnovica- Západ

.....

Skóre(0-7)

18.ZNOVUPOZNANIE (REKOGNÍCIA)

- Pacientovi/ke povedzte:
„Teraz Vám budem trochu napovedať. Poviem Vám, napríklad, tri mená (názvy ulíc, miest atď.) a Vy z nich skúste vybrať to správne. Takto budeme pokračovať aj v ďalších položkách.“

Jozef Kováč		Ján Kováč		Ján Stolár	
Hlavná cesta		Majerská cesta		Majerská ulica	
37		76		73	
Žarnovica		Sobrance		Želiezovce	
Východ		Západ		Juh	

Skóre(0-5)

PAMÄŤ

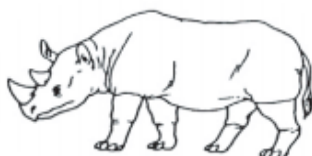
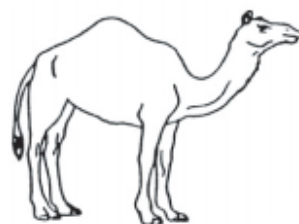
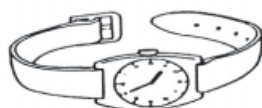
LIST PRE PACIENTA/KU

8.)

ZATVORTE SI OČI

9.)

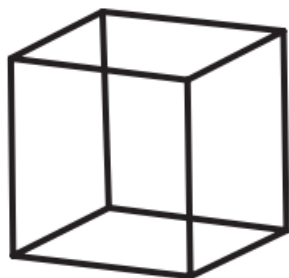
10.)



13.)

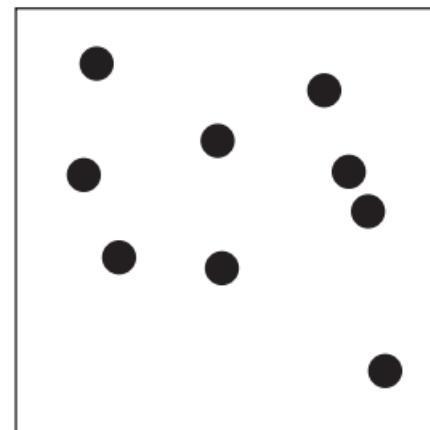
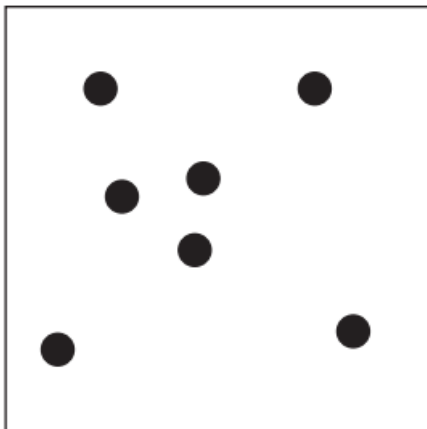
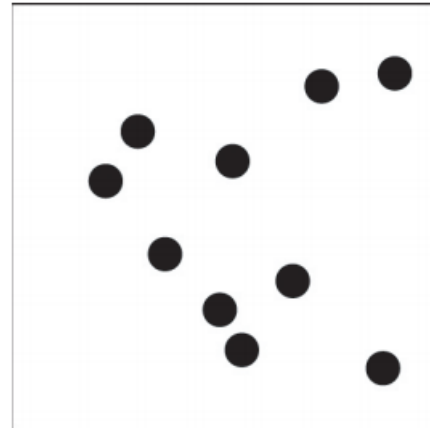
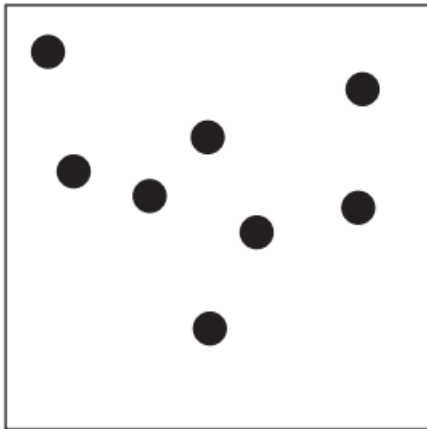
**OBYČAJNÍ
DCÉRA
VINNÁ
VÄZNICA
HANBA**

14.)



Hodiny

15.)



16.)

